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Gut Bacteria Liberate Hidden Toxins Found In Grains

Toxicology: The masked toxins currently slip past food safety monitoring

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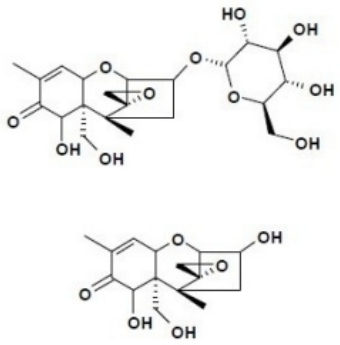

Unmasked
Crops such as wheat modify the mycotoxin deoxynivalenol with a glucose molecule (top). Human gut bacteria can cleave off the sugar and release the free toxin (bottom).
Credit: Chem. Res. Toxicol.

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Fungal Blight

Crops such as wheat, corn, and peanuts sometimes harbor chemicals from molds that grow on the plants. Some of these compounds are seemingly harmless derivatives of toxins produced by the fungi. For the first time, researchers have shown that **human gut bacteria can break down these compounds** and release the toxins, which can cause gastrointestinal and neurological damage (*Chem. Res. Toxicol.*, DOI: **10.1021/tx300438c**).

The findings strongly suggest that these masked toxins may not stay hidden within our digestive tracts, and that government agencies may need to regulate the chemicals, the researchers say.

Scientists have long known that fungi, such as *Fusarium graminearium*, deposit toxins on food crops. These so-called mycotoxins can contaminate the food supply, causing a wide range of nasty effects and even death in people and livestock. As a result, many countries set a limit for the amount of mycotoxins in food and animal feed.

But in the past decade, scientists have discovered that mycotoxins can hide. The toxins are harmful to the crops themselves, so, as a defense strategy, the plants neutralize the mycotoxins by tacking on a sugar or sulfate group to the chemicals. Because of this chemical modification, these masked mycotoxins slip past current detection methods used by food safety inspectors. Also scientists don't know much about the toxicity of the derivatives.

If cereal grains hold masked mycotoxins, "what happens to the compounds during human digestion?" asks **Chiara Dall'Asta**, a chemist at the **University of Parma**, in Italy. "Are they less toxic or as toxic as their parent compounds?"

To answer those questions, Dall'Asta and her colleagues simulated the entire human digestion process from mouth to large intestine in their laboratory. They watched what happened to three common masked mycotoxins in this simulated digestive tract. One compound was the toxin deoxynivalenol masked with a glucose molecule, and the other two were derivatives of zearalenone modified with either glucose or a sulfate group.

When the team incubated the compounds with digestive juices and enzymes from the mouth, stomach, and part of the small intestine, nothing happened. But when the researchers mixed the two chemicals with human fecal samples in a warm airless bath for a day, bacteria in the feces freed the toxins. The experiment mimicked conditions in the large intestine. It took the microbes 24 hours to completely cleave the masked deoxynivalenol, but only 30 minutes to

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The mold Fusarium graminearium grows on maturing wheat (visible on the lighter heads) and deposits harmful mycotoxins.
Credit: AGER Project

free zearalenone.

A team in Scotland, led by **Silvia Gratz** at the **University of Aberdeen**, recently reported similar findings (*Appl. Environ. Microbiol.*, DOI: **10.1128/AEM.02987-12**). Those researchers found that fecal bacteria could free deoxynivalenol within about six hours.

These are the first reports that, under body-like conditions, human gut bacteria can unmask mycotoxins, says **Franz Berthiller**, at the **University of Natural Resources and Life Sciences**, in Vienna, who was not involved in either study. He points out that the toxicology of the masked compounds needs further study. In particular, researchers must determine how much of the freed toxin reaches the bloodstream, he says. If the toxins are liberated only inside the large intestine, the body may absorb very little of the chemicals, Berthiller adds.

Dall'Asta agrees about the need for more toxicology studies. And she hopes that the Scottish study and her work will prompt food safety regulators to consider monitoring for masked mycotoxins.

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